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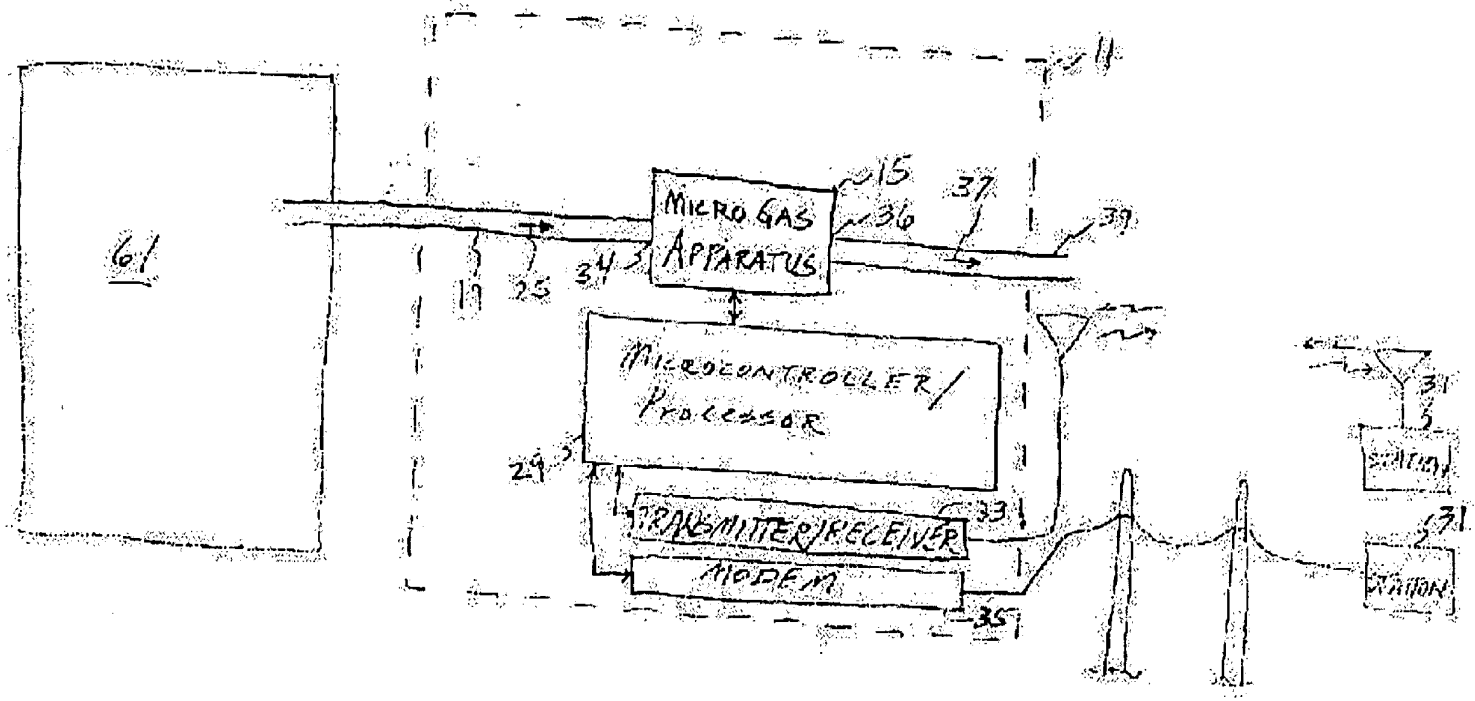

61
MICRO GAS APPARATUS
15
36
37
39
34
25
MICROCONTROLLER / PROCESSOR
29
TRANSMITTER/RECEIVER
33
MODEM
35
31
31

FIG. 1

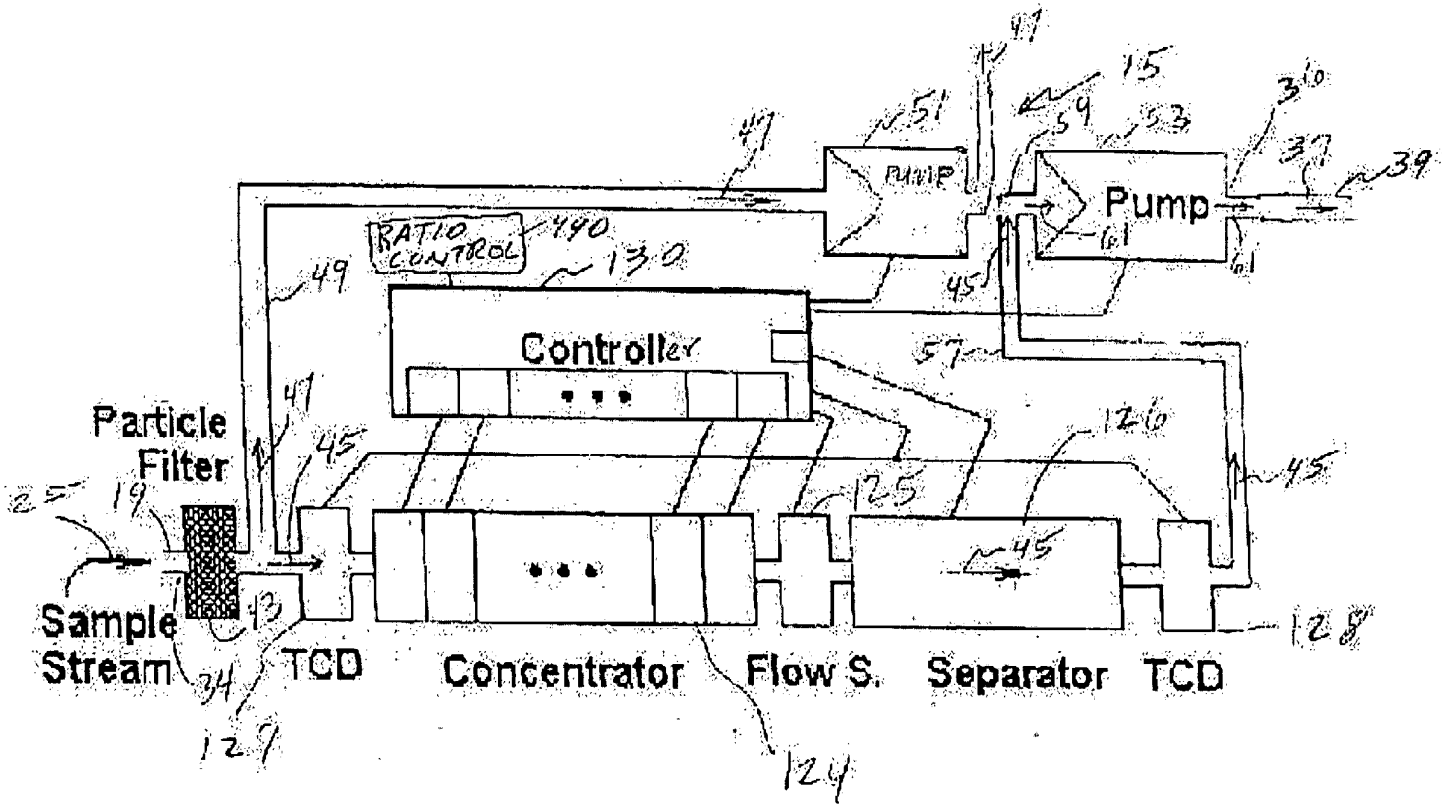

Pump
RATIO CONTROL
Controller
Particle Filter
Sample Stream
TCD
Concentrator
Flow S.
Separator
TCD

FIGURE 2

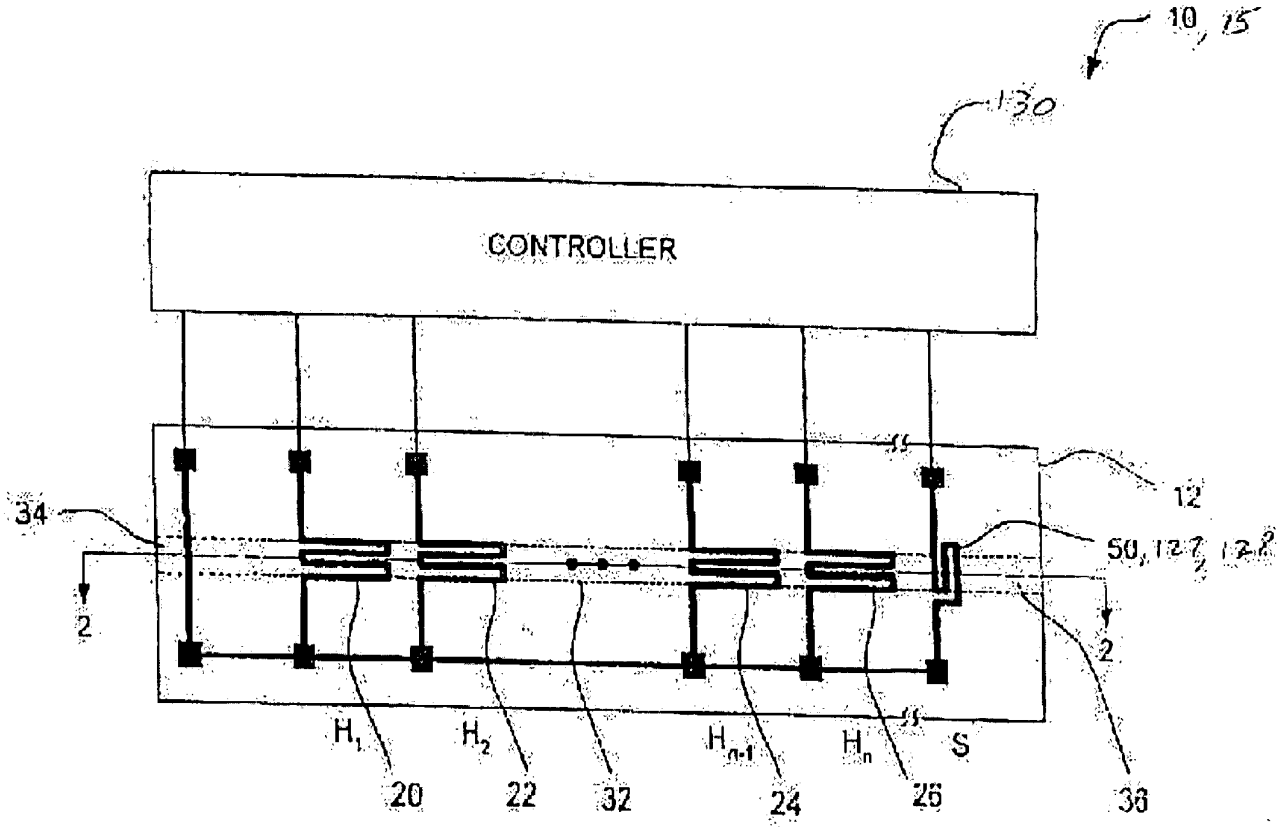

10, 15
130
CONTROLLER
12
34
50, 12', 12''
2
2
H_1
H_2
H_{n-1}
H_n
S
20
22
32
24
26
36

FIGURE 3

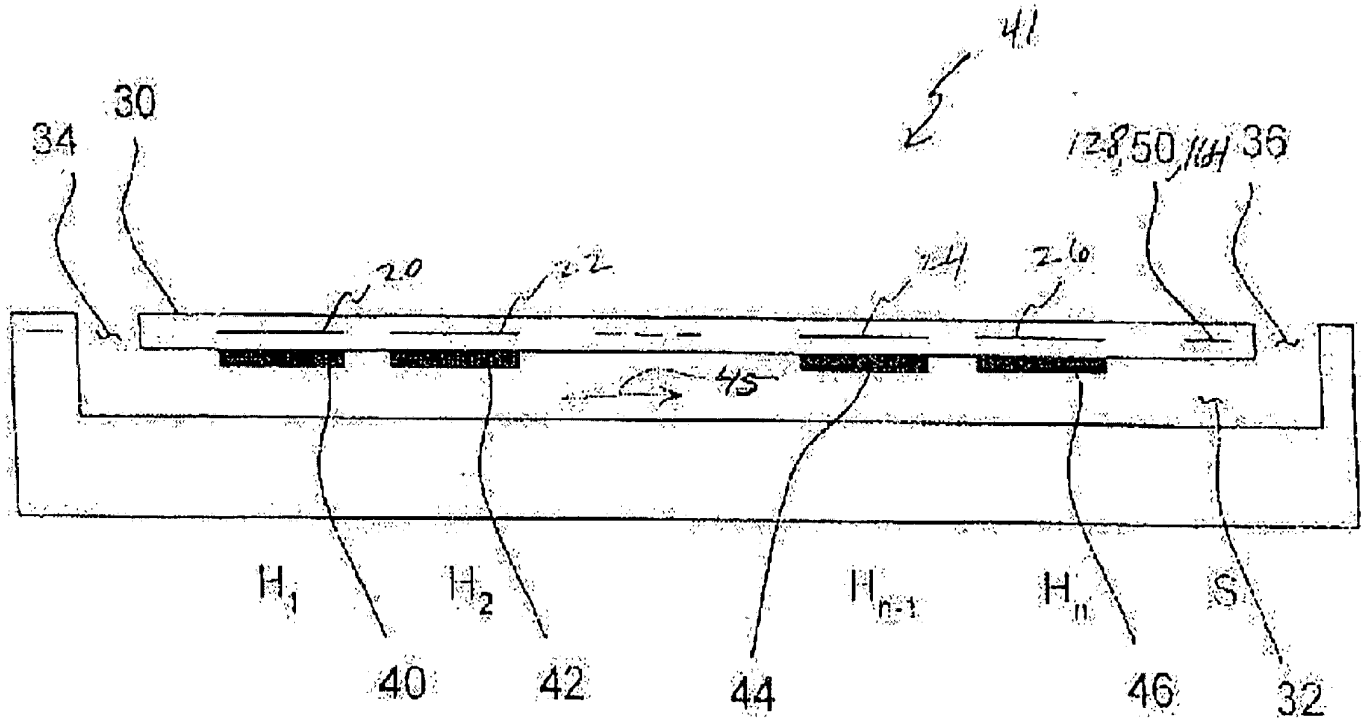


Fig. 4

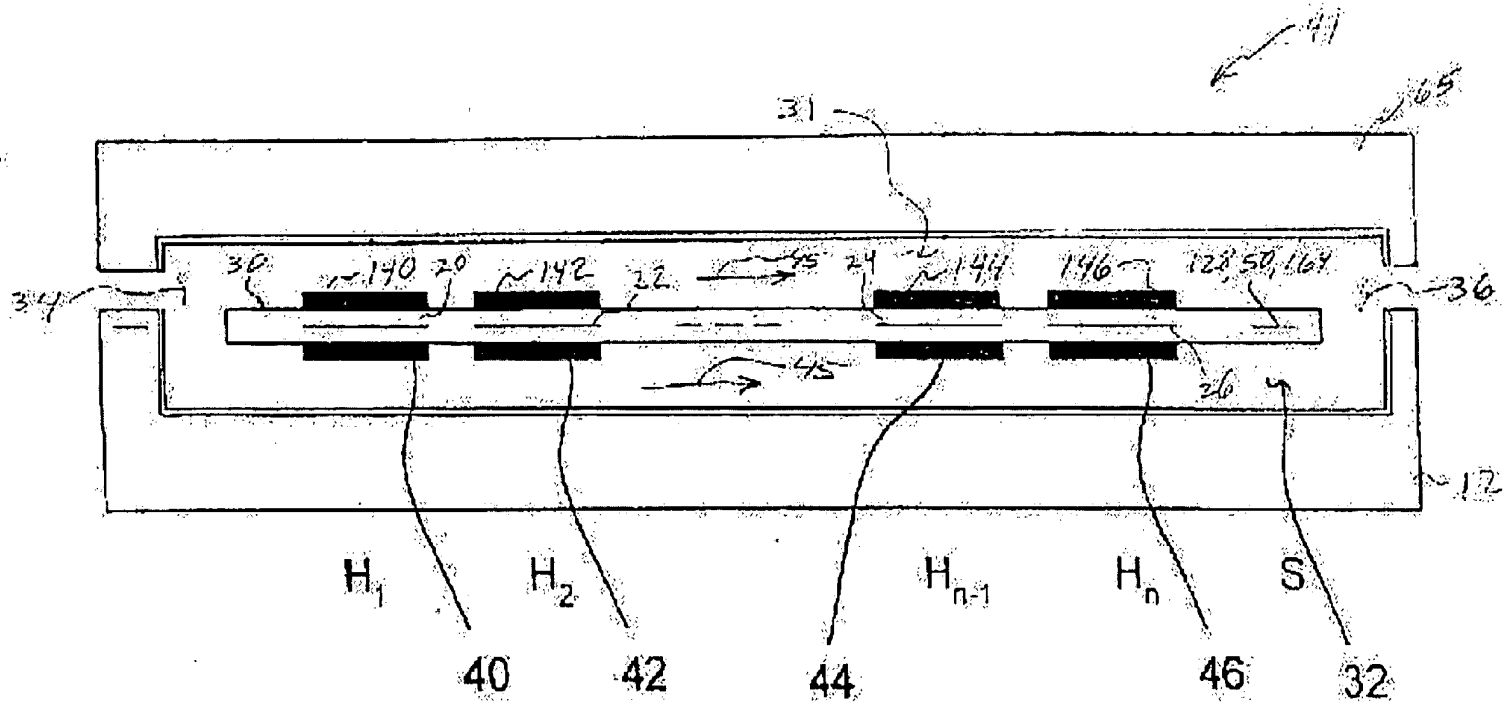

41
31
165
30
140
70
142
22
45
24
144
146
128, 50, 164
34
36
45
26
12
H_1
H_2
H_{n-1}
H_n
S
40
42
44
46
32

FIGURE 5

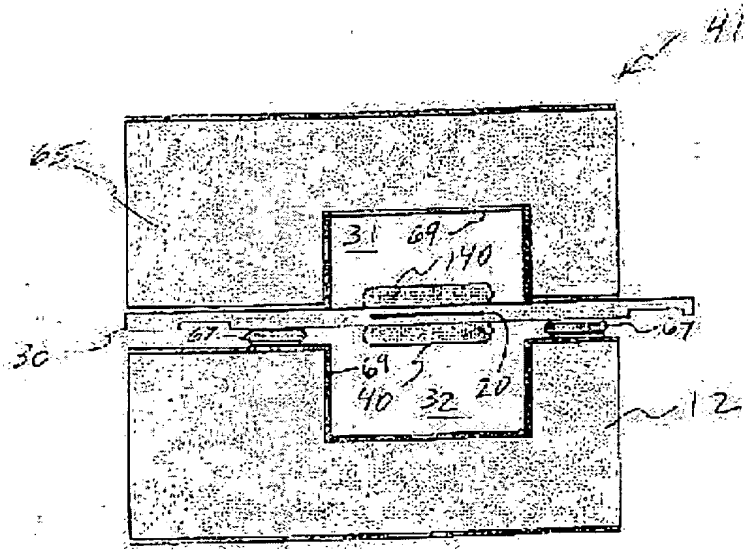


FIGURE 6a

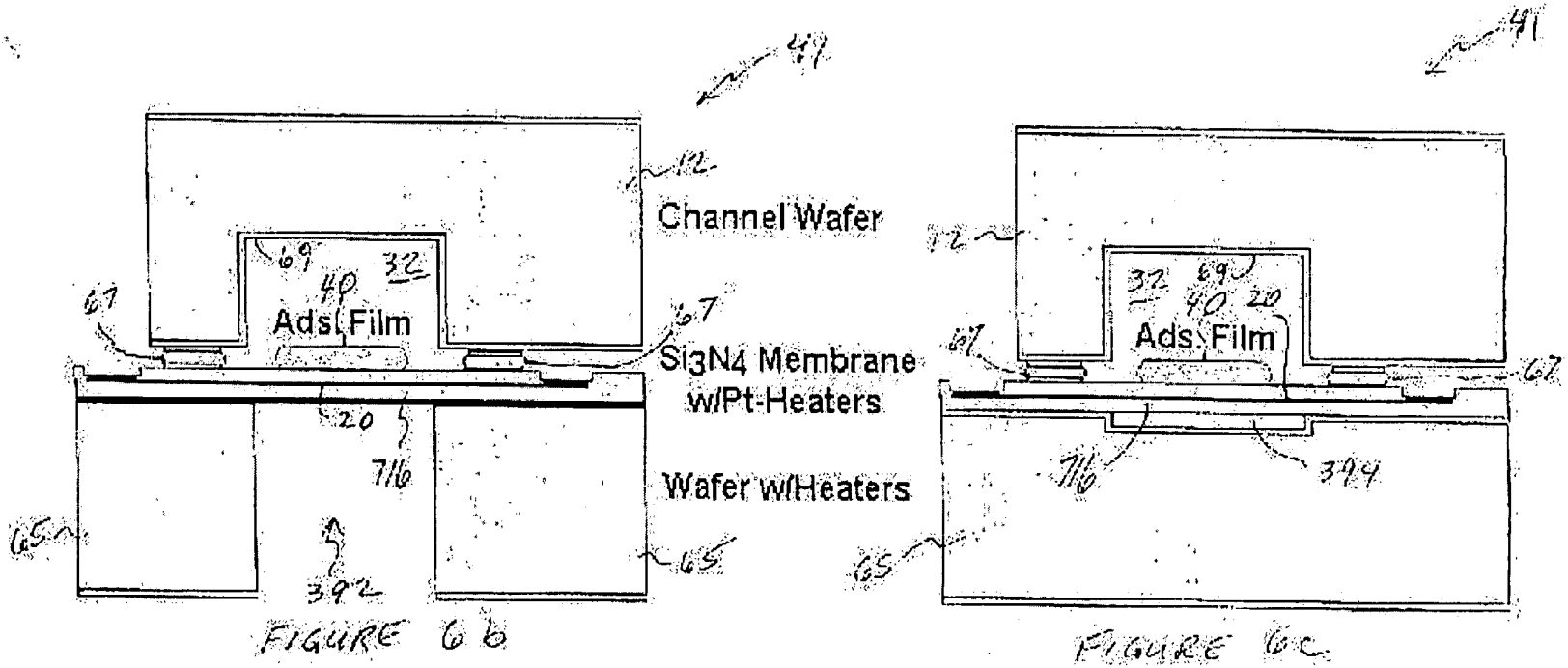


FIGURE 6b

FIGURE 6c

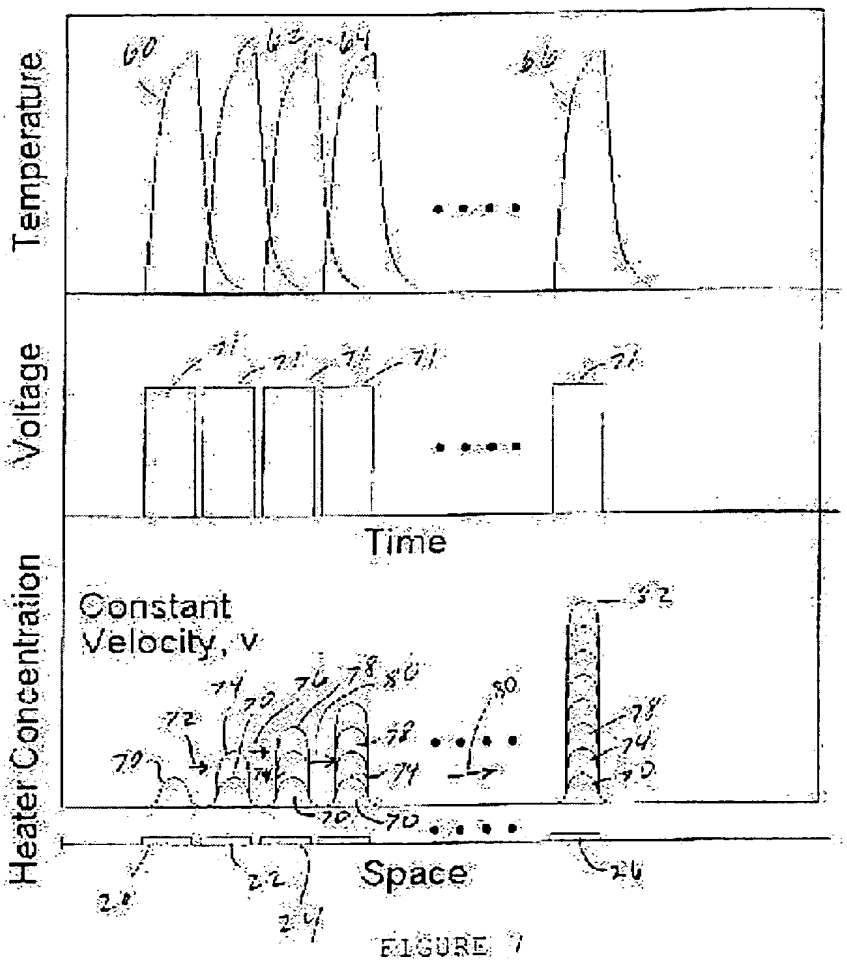

Temperature
Voltage
Time
Heater Concentraiion
Constant
Velocity, v
Space

FIGURE 7

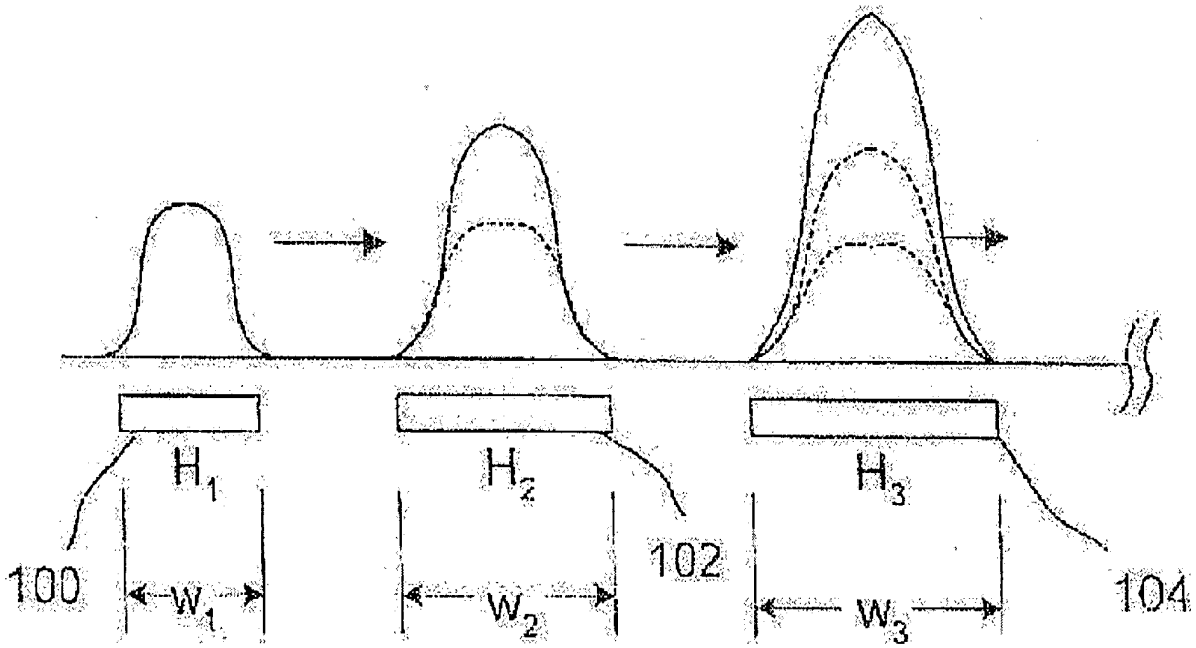


Figure 3

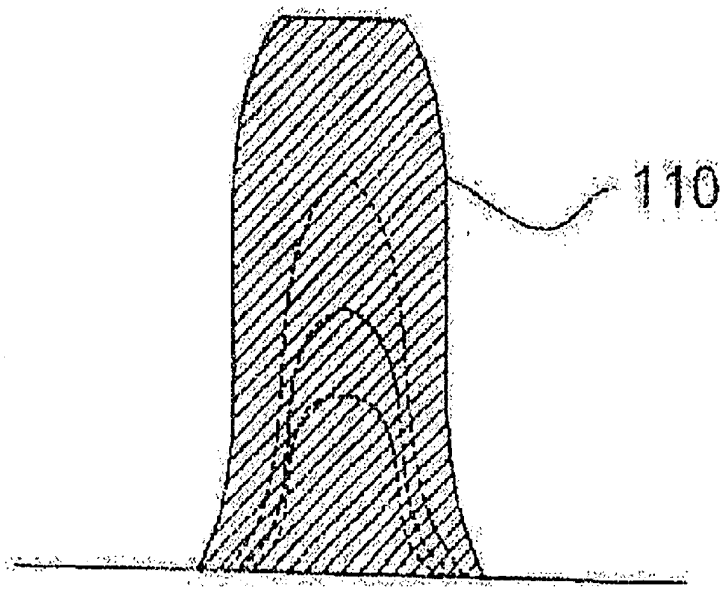


Figure 4

FIGURE 10

Comparison of Detection Limits in pg/s (MDL) and Selectivities × 10^3 (SEL)

		this work		ref 9 (without background correction)		ref 9 (with background correction)		ref 7[a] (echelle)		ref 8[b] (with background correction)	
element	wavelength, nm	MDL	SEL	MDL	SEL	MDL	SEL	MDL	SEL	MDL	SEL
N	174.2	7.0	6								
S	180.7	1.7	150								
Hg	184.9	0.1	3000								
C	193.1	0.5								53	
P	177.5	1.5	25								
C	247.9	2.6		2.7							
Si	251.6	7.6	90	9.2	1.6			58	3.9		
P	253.6			3.9	51			4.2	28		
Hg	253.7	0.1	5000	0.6	77			2.0	91		
Br	470.4			33	0.27	67	1.0	20	1.4	38	0.53
Br	478.6	75	19	34	0.80						
Cl	479.5	30	25	43	0.61	86	1.5			32	1.9
Cl	481.0							32	2.4		
H	486.1	2.2		16							
S	545.4	7.2	26	33	0.08	52	4.6	126	0.25	294	0.07
D	656.1	2.5	0.6	7.4	0.19						
H	656.3	3.0		7.6						37	
F	685.6	40	20	30	0.57	180	11.4	17	3.5	11	0.62
O	777.2	75	25								

[a]Reference 7 uses peak width at base instead of peak width at half height to determine MDL, and the numbers have been adjusted accordingly for comparison. [b]Reference 8 uses 1σ instead of peak to peak (6σ) to measure noise for MDL, and their numbers have been adjusted accordingly for comparison. [c]Versus hydrogen.

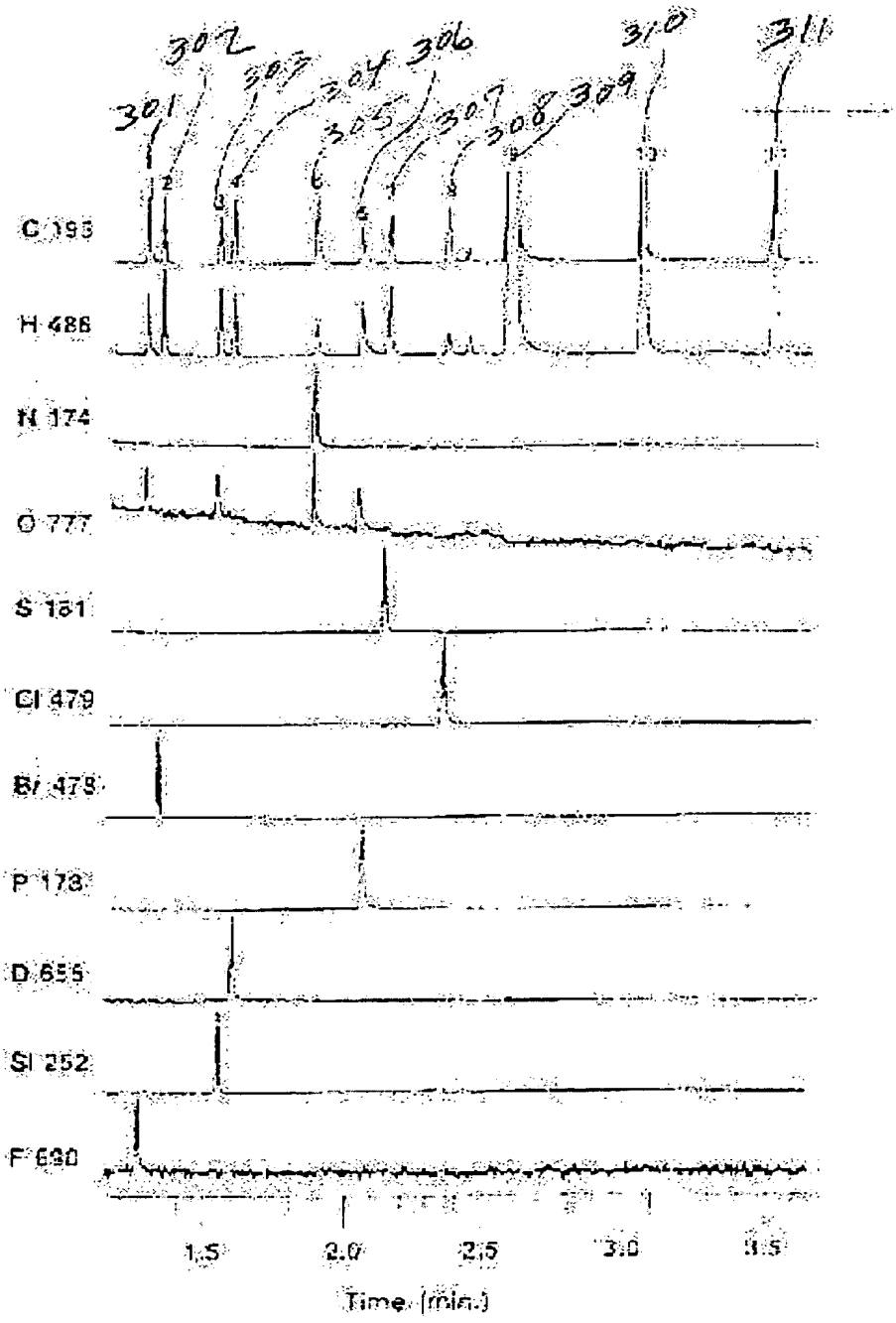

301
302
303
304
305
306
307
308
309
310
311
C 193
H 486
N 174
O 777
S 181
Cl 479
Br 478
P 178
D 656
Si 252
F 690
1.5
2.0
2.5
3.0
3.5
Time (min.)

FIGURE 11

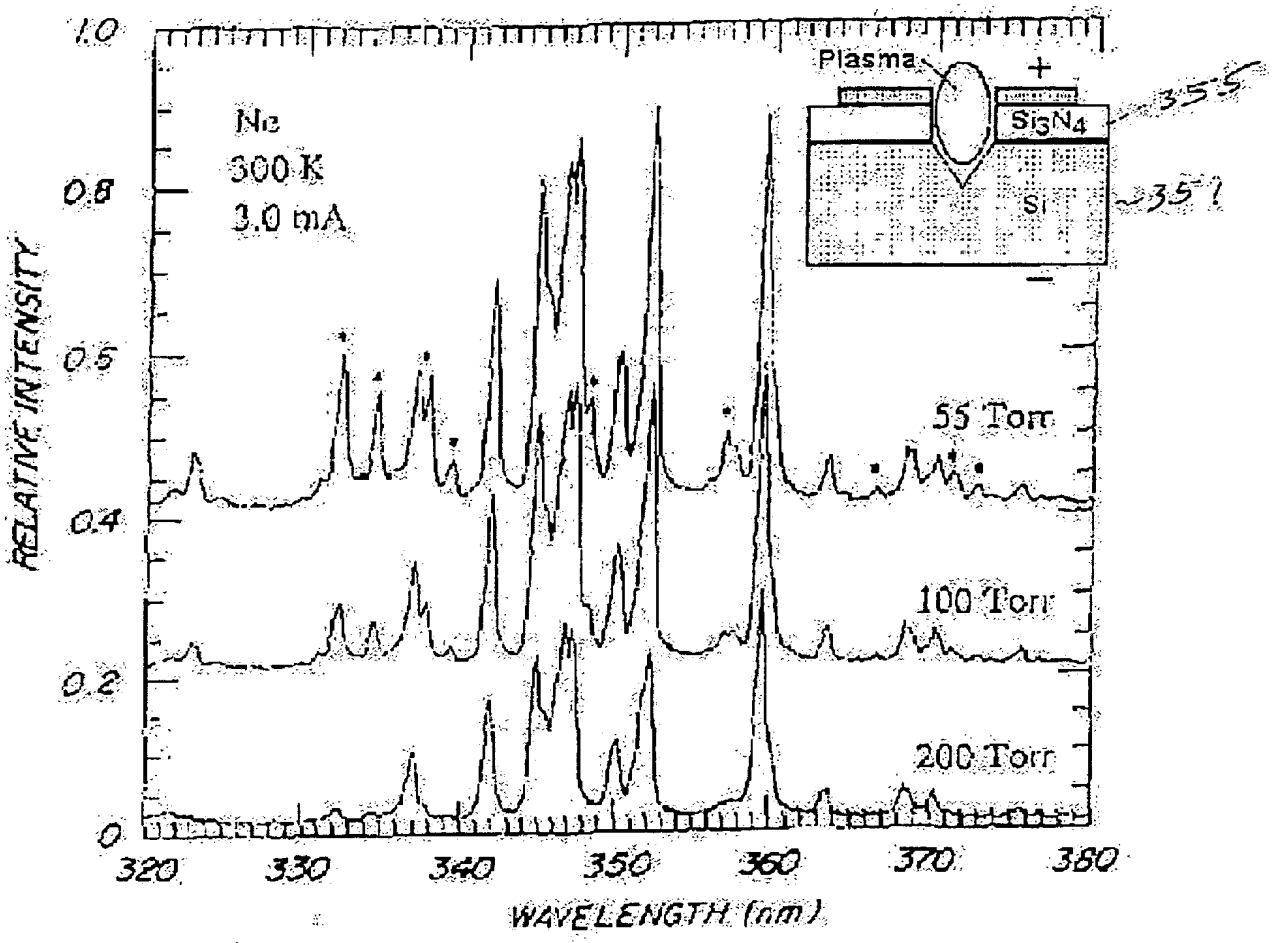

1.0
0.8
0.5
0.4
0.2
0
RELATIVE INTENSITY
N2
300 K
3.0 mA
55 Torr
100 Torr
200 Torr
320
330
340
350
360
370
380
WAVELENGTH (nm)
Plasma
+
Si3N4
Si
355
351
—

Figure 12

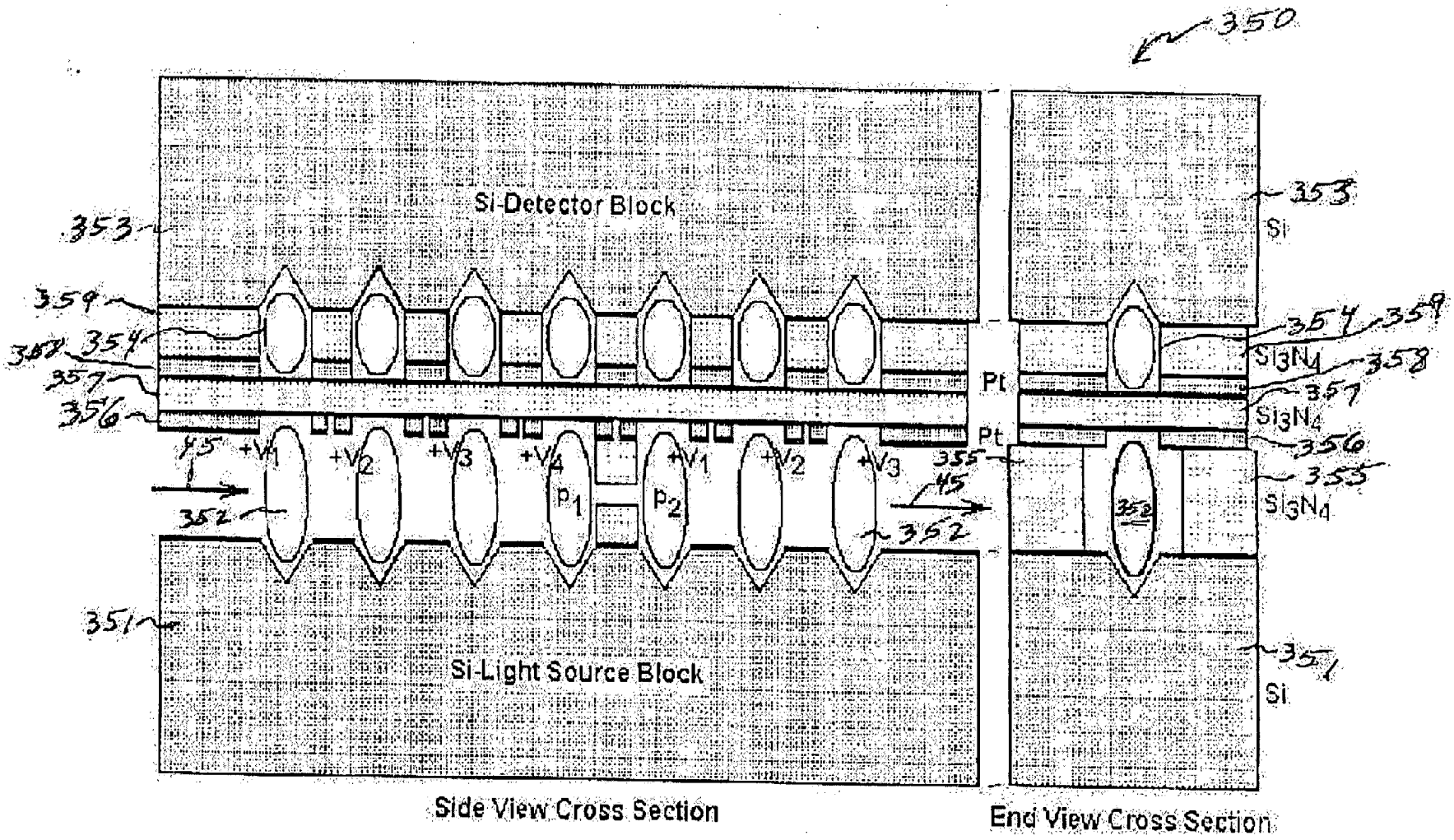

350
Si-Detector Block
353
359
354
357
356
Pt
Pt
45
+V1
+V2
+V3
+V4
352
P1
P2
355
Si3N4
358
Si
351
Si-Light Source Block
Side View Cross Section
End View Cross Section

FIGURE 13

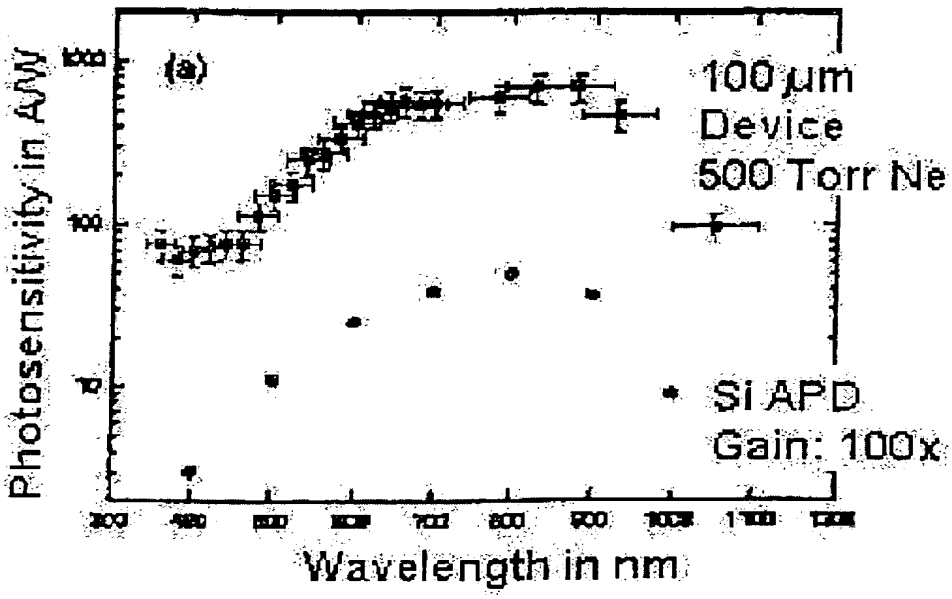
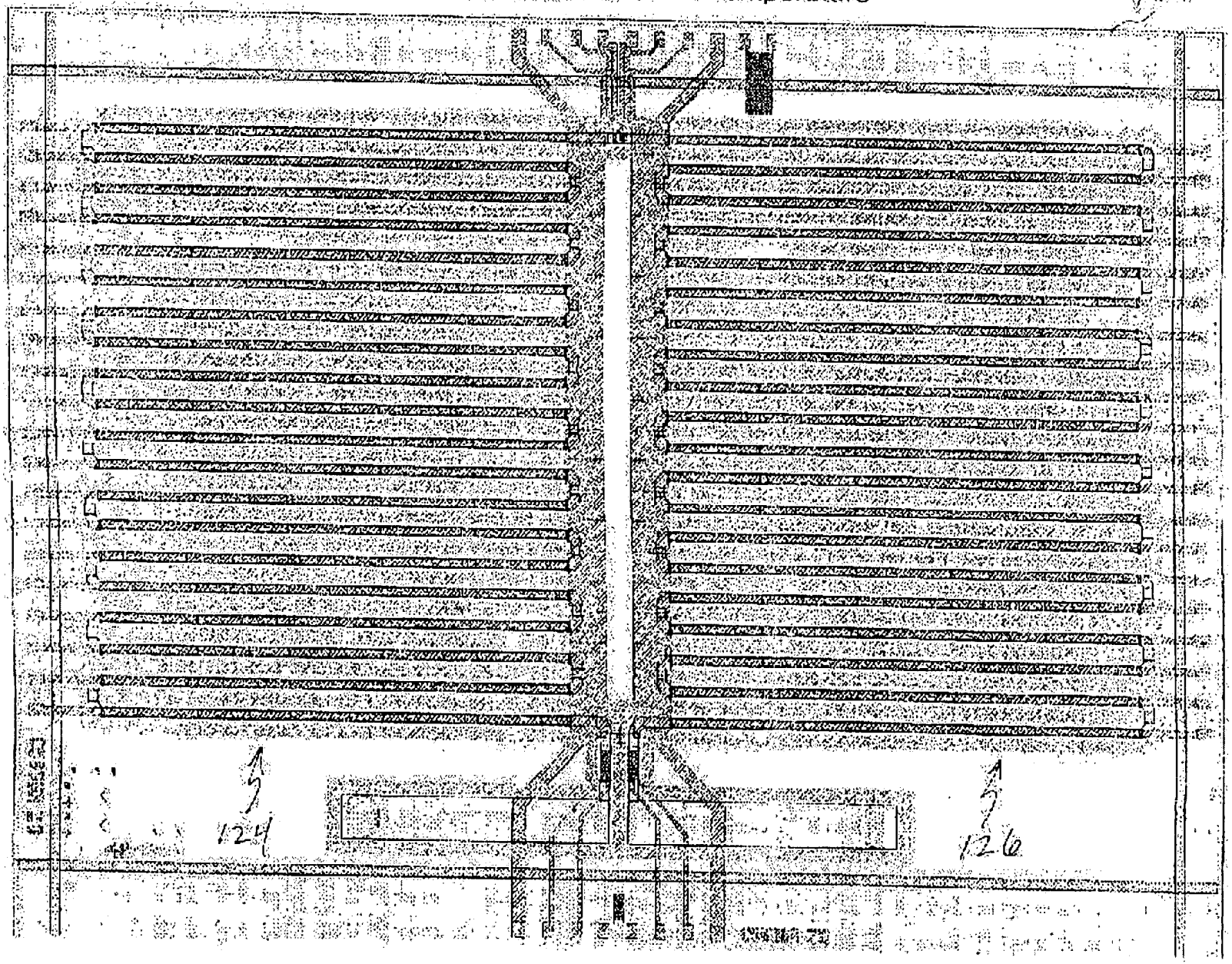

(a)
100 µm
Device
500 Torr Ne
Si APD
Gain: 100x
Photosensitivity in A/W
Wavelength in nm

FIGURE 14

Sensors: Flow and Temperature

401



20-Element Pre-Concentrator Diff. TC, 20-Element Separator

Figure 15

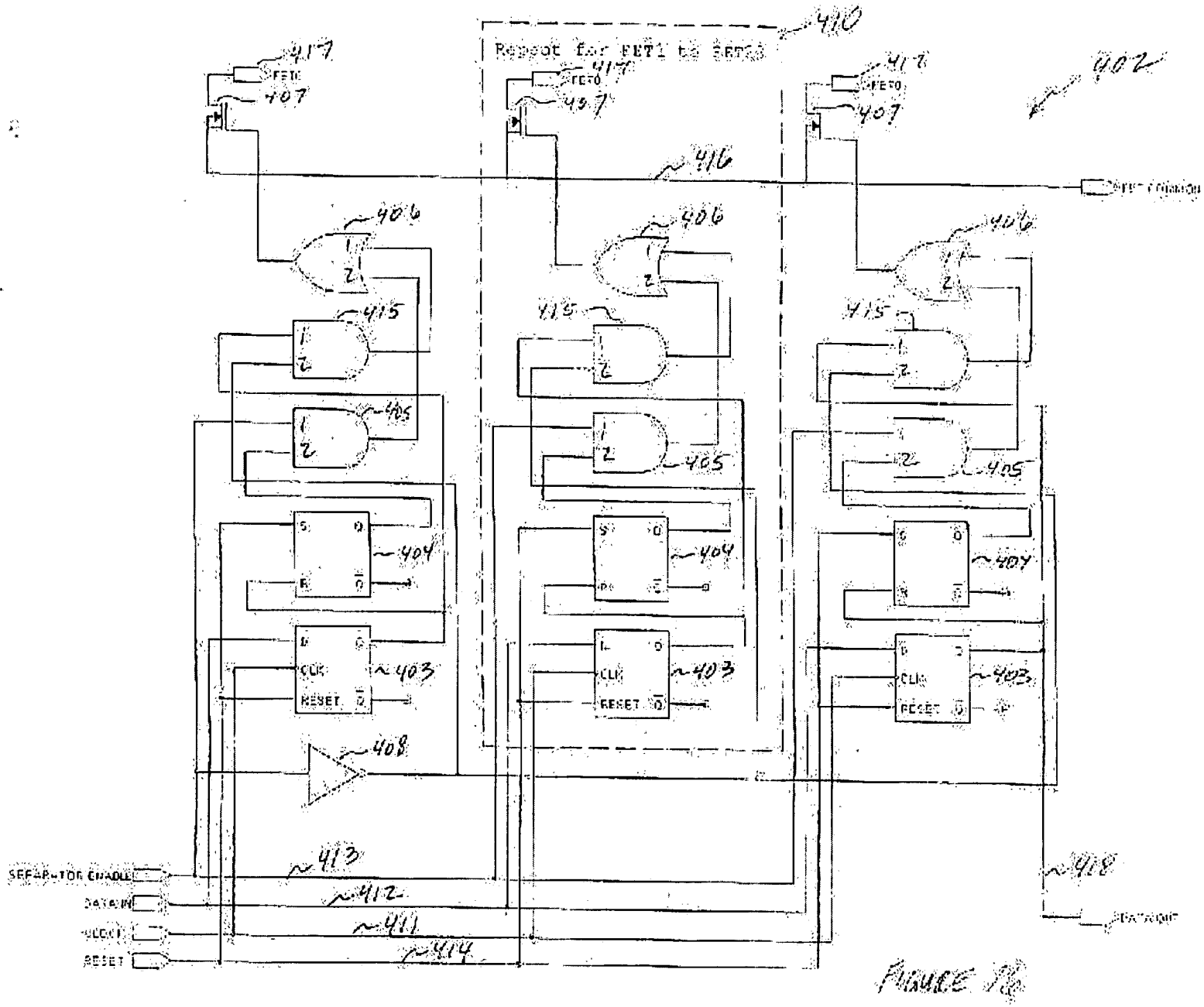

Repeat for FET1 to FET3
FET0
FET1
FET2
FET3
407
416
406
415
405
404
403
408
413
412
411
414
410
417
402
418
SEPARATOR ENABLE
DATA IN
CLOCK
RESET
CLR
RESET

FIGURE 4

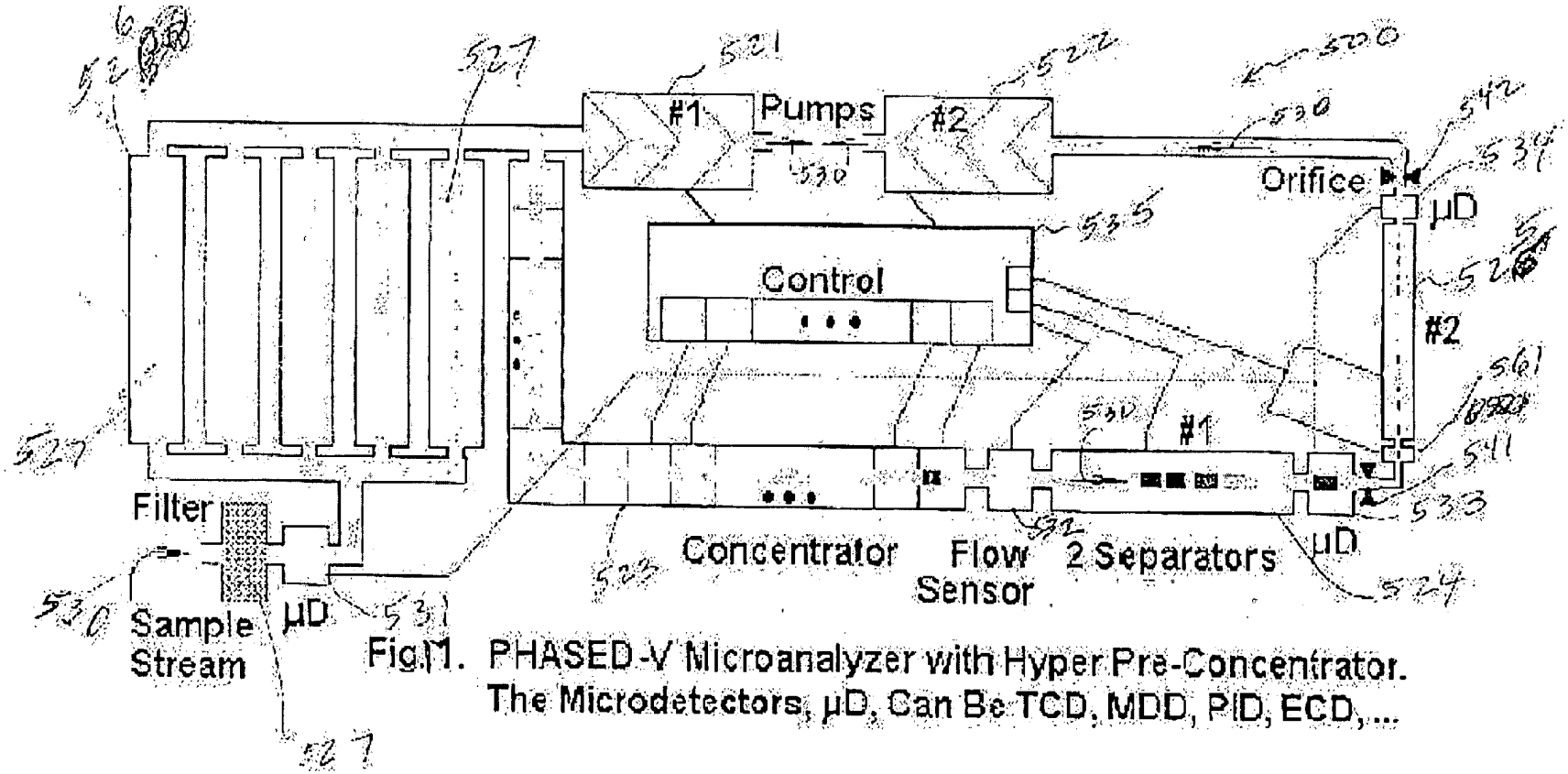


Fig.11. PHASED-V Microanalyzer with Hyper Pre-Concentrator. The Microdetectors, μD, Can Be TCD, MDD, PID, ECD,...

FIGURE 17

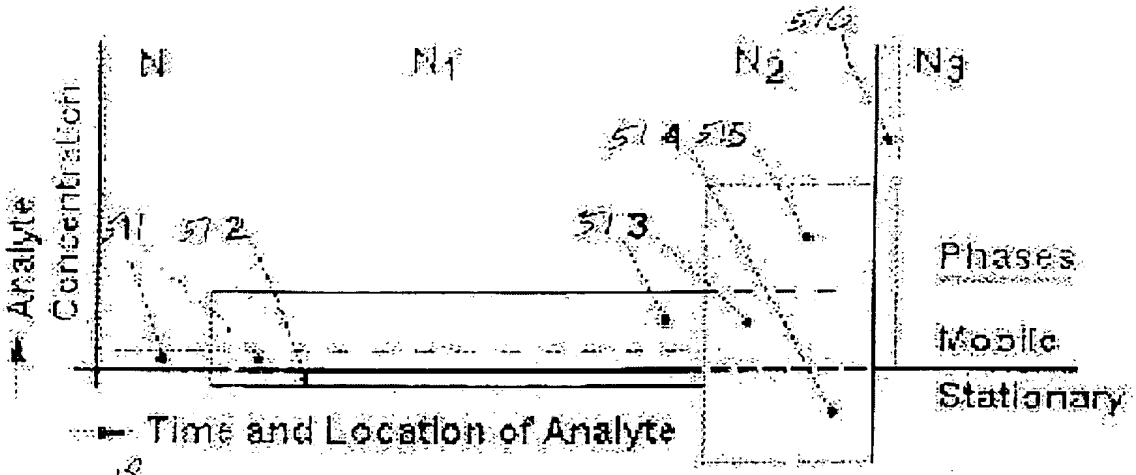


Fig. 8. Pre-Concentrated, Multi-Stage Pre-Concentration Concept and Examples

Analyte Masses = Film Length x Concentration

	N ppt	N_1 ppt	N_2 ppt	N_3 ppt
A	∞x1	500x100	5x10,000	1x 50,000
B	∞x1	1000x100	10x10,000	1x100,000
C	∞x1	5,000x100	50x10,000	1x500,000
D	∞x1	10,000x100	100x10,000	1x520,000+loss
E	∞x1	100,000x100	1,000x10,000	10x1,000,000 (10^7)

Figure 19

Pres.Drop at 100 cm/s, 100x100 µm

No. of Elem. N1	Length L	Pres. Drop Δp	Peak P. Q
-	cm	psi	watts
50	0.5	2.629	20.5
505	0.1	5.311	41.3
1010	0.1	10.621	82.6

FIGURE 20

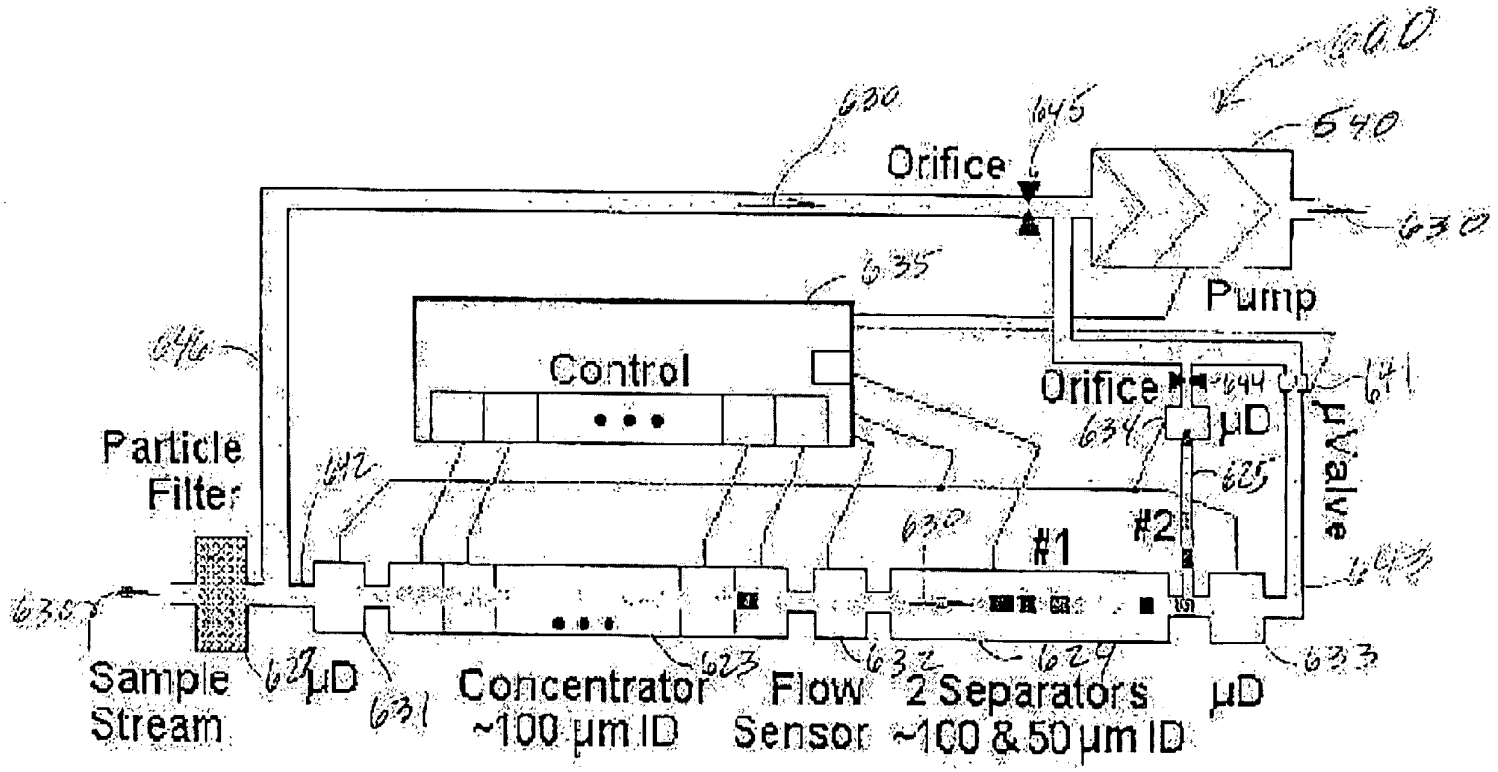


Fig. 1. GC-GC Microanalyzer Implemented on a PHASED Platform.
The Microdetectors, µD, Can Be TCD, MDD, PID, ECD, ...

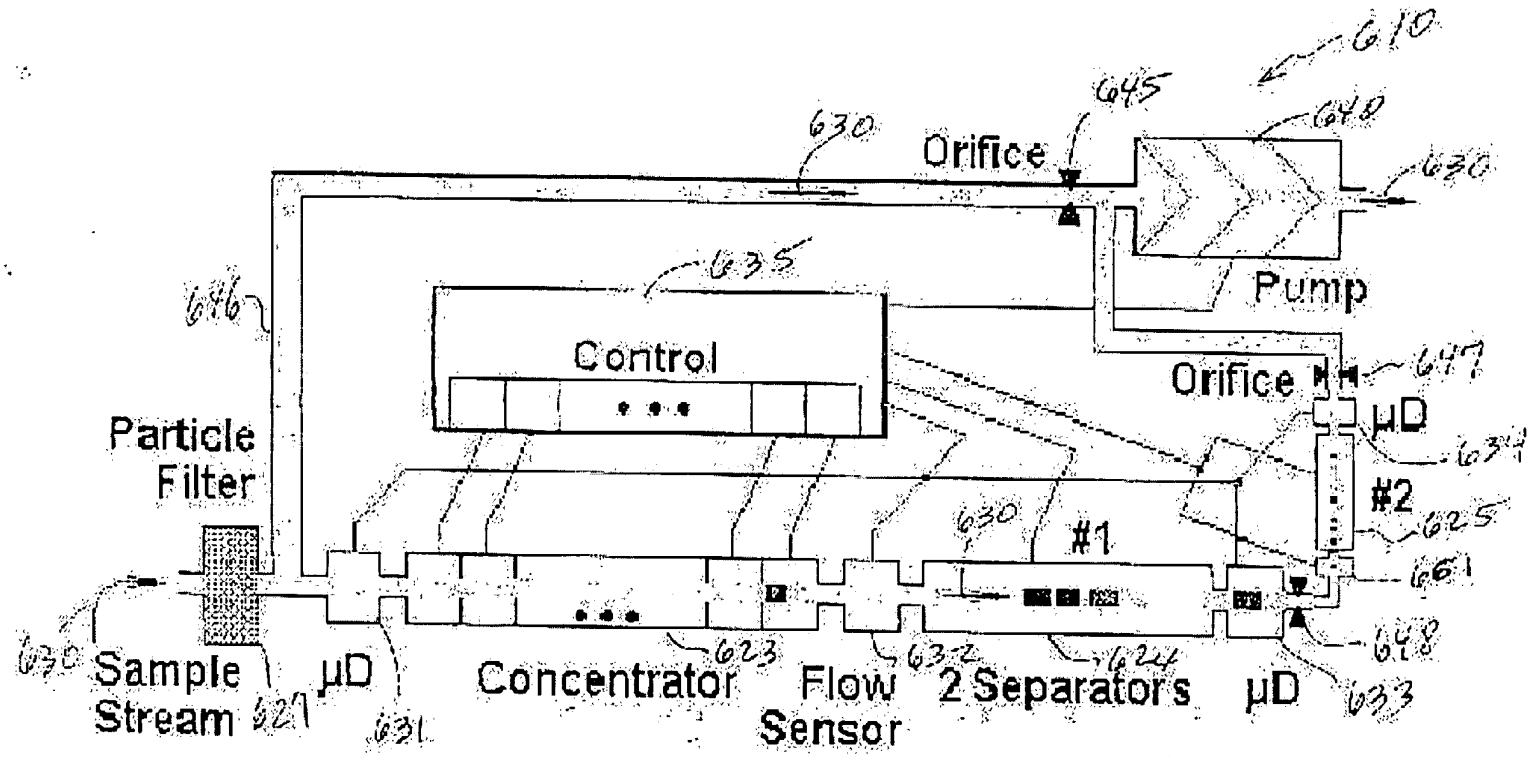


Fig.2. GC-GC Microanalyzer Implemented on a PHASED Platform. The Microdetectors, µD, Can Be TCD, MDD, PID, ECD, ...

FIGURE 2 2

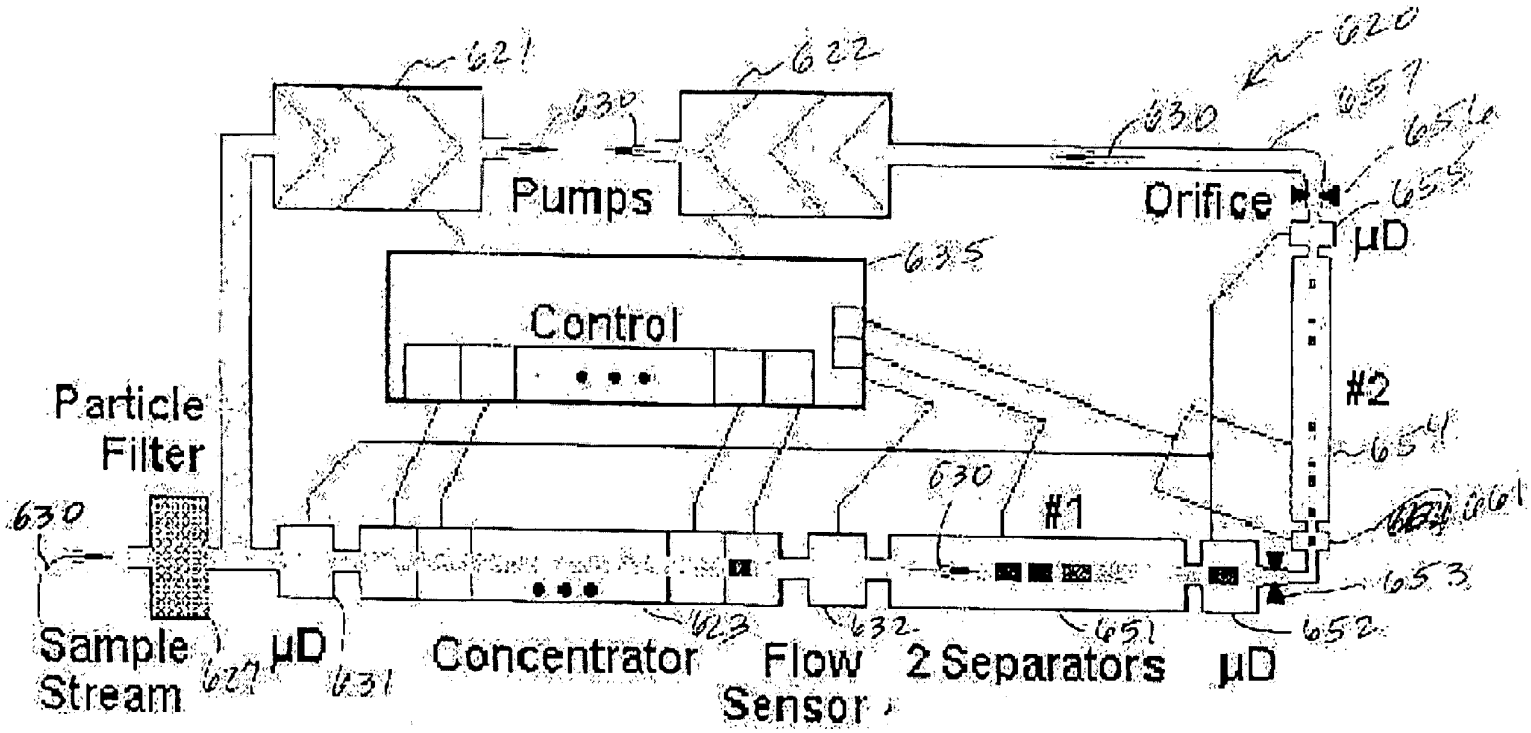


Fig.23. GC-GC Microanalyzer Implemented on a PHASED Platform. The Microdetectors, μD, Can Be TCD, MDD, PID, ECD, ...

Table: Design of μGC-μGC System on the Basis of a PHASED Structure

	v in cm/s	ID in cm	L in cm	s in μm	l in mm	V in cm3/min	Δp in psi	
μGC-1	50	0.014	25	1	5	0.588	0.671	
μGC-2	250	0.007	10	0.15	2.5	0.588	5.363	
			Half-Width	k=6	k=0.2	k=2	k=2	k=0.2
	v	to	Δt	tR	v(optimal)	v(optimal)	R	ΔR(v-vo)
	cm/s	ms	ms	sec	cm/s	cm/s	-	%
μGC-1	50	500	20	3.00	58.8	56	8.76	2.5
μGC-2	250	40	2	0.24	149.2	118	8.00	6.2

FIGURE 27

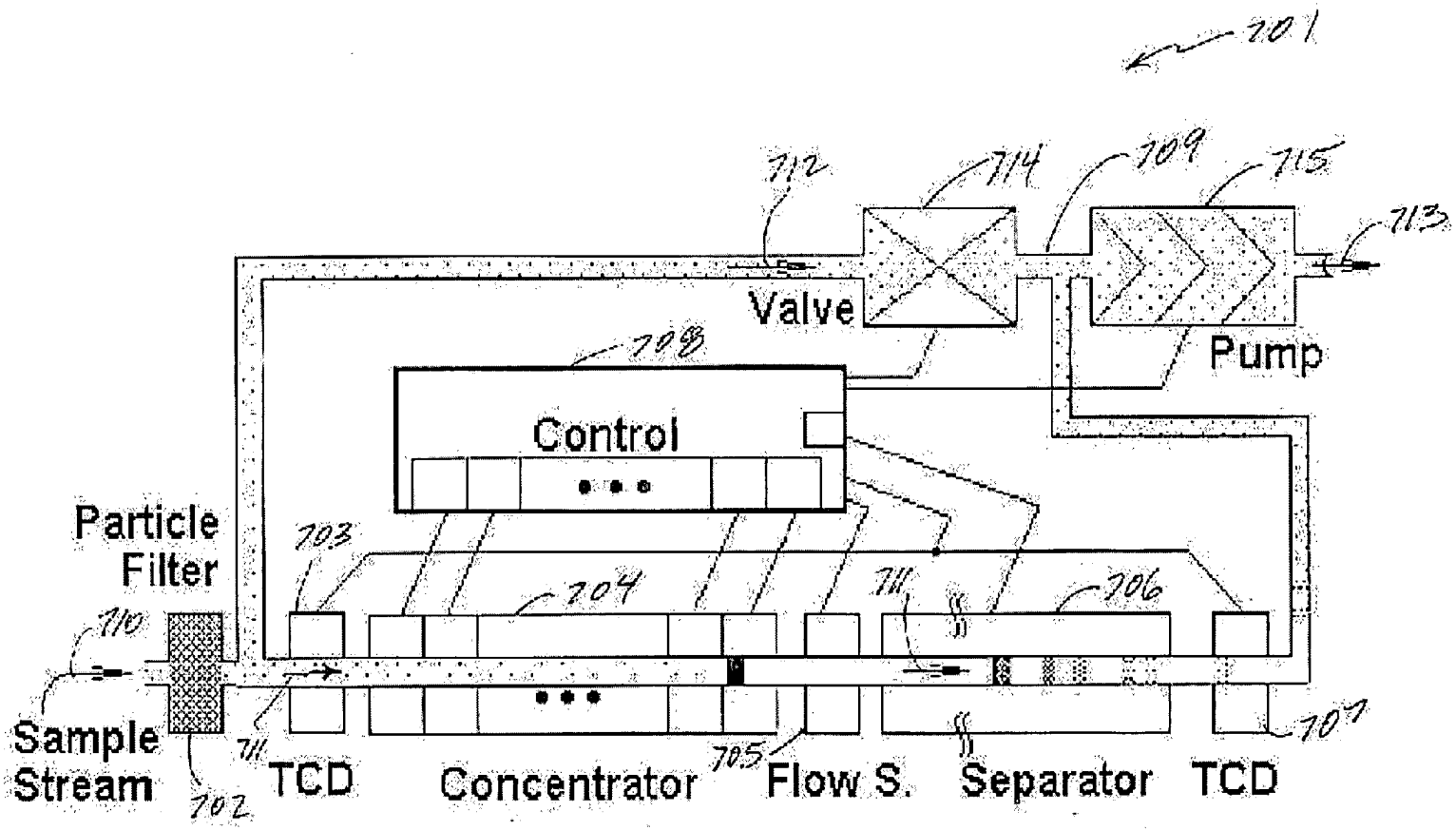

701
712
714
709
715
713
Valve
Pump
708
Control
Particle
Filter
703
704
711
706
710
Sample
Stream
711
TCD
Concentrator
705
Flow S.
Separator
TCD
707
702

FIGURE 25

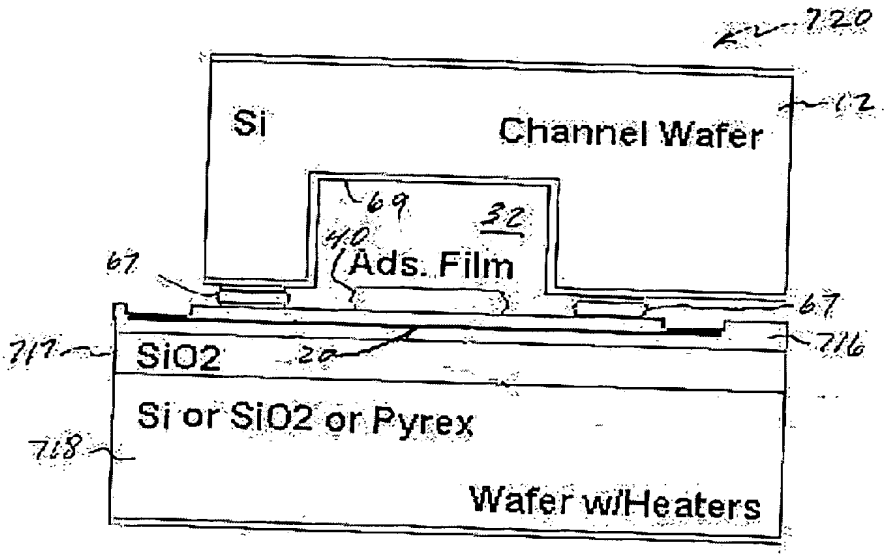


FIGURE 26a

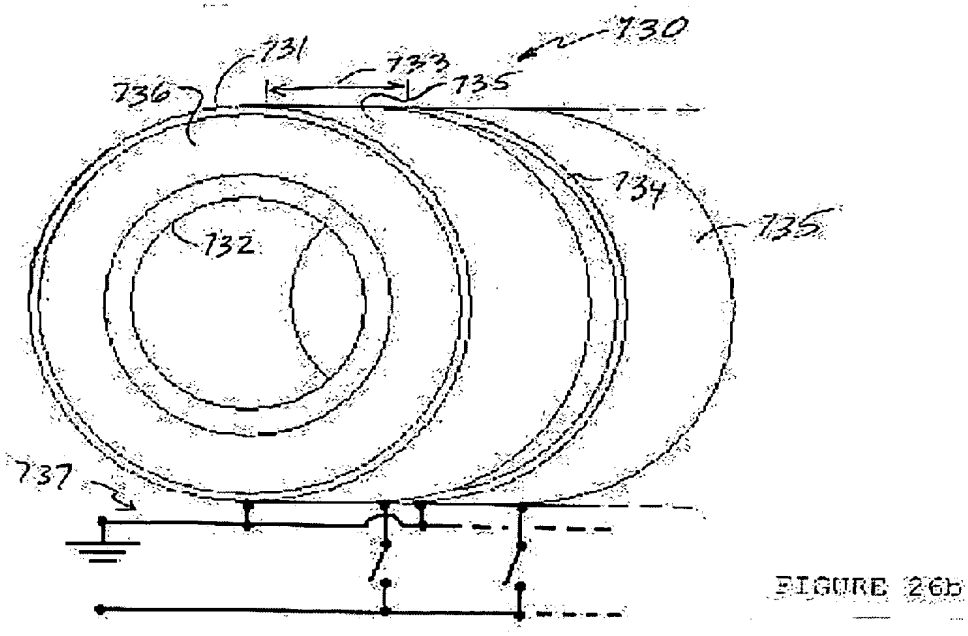


FIGURE 26b